Diverse Terrain on Earth's 'Twin'

"Surface of Venus: Evidence of Diverse Landforms from Radar Observations" by Michael C. Malin and R. Stephen Saunders, in *Science* (May 27, 1977), 1515 Massachusetts Ave., N.W., Washington, D.C. 20005.

Because of similarities in size, density, and position in the solar system, Venus is generally considered the earth's "twin" planet. Interpreting high-resolution pictures made with radar telescopes—which can penetrate the opaque, intensely hot, Venusian atmosphere—two astronomers from the California Institute of Technology suggest that even Venus's geographical features are comparable to those on earth.

Malin and Saunders find that Venus, like earth, has a mobile crust subject to the forces of tectonism (movement of crustal plates) and volcanoes. A "startling" trough system 1,400 km long, 150 km wide, and about 2 km deep bears a striking resemblance to the East African Rift system on Earth. It suggests modification of Venus's crust by tectonic spreading and extension.

Evidence of volcanic activity is found in a large dome (300 km across, 1 km high, capped by a small, steeply sloped crater), reminiscent of similar features on Mars, and in clusters of smaller mountains resembling areas on earth associated with volcanic activity, such as Arizona's San Francisco Peaks region.

The trough system and volcanic formations, the authors observe, suggest a "geologically active" planet, perhaps "rivaling the earth in the breadth of features portrayed on its surface."

Acoustical Illusions

"The Ohm-Seebeck Dispute, Hermann Von Helmholtz, and the Origins of Physiological Acoustics" by R. Steven Turner, in *British Journal for the History of Science* (vol. 10, no. 34, 1977), University of Lancaster, Department of History, Lancaster LA1 4YG, England.

In 1843, Georg Simon Ohm (1787–1854), formulator of the law of electrical circuits that bears his name, conceived a revolutionary theory of physical acoustics. "Ohm's law" stated that the ear, when exposed to complex musical waveforms, can separately analyze their distinct, component waves. The theory, writes Turner, a historian at the University of New Brunswick, was quickly discredited but later played a key role in studies of the relationship between the mind and the senses.

With the assistance of a new sound-producing device—the siren—Ohm determined that complex waves are decomposed by the ear, just as the ear "hears out" separate notes of a chord. August Seebeck countered by demonstrating that certain complex waves

combine to form distinct "combination" tones. Ohm's law disavowed such waves; but, argued Seebeck, the ear can hear them.

In 1856, Hermann von Helmholtz, German philosopher and physicist (1821–94), settled the dispute in Ohm's favor. Using more refined instruments to measure sound, Helmholtz discovered that Seebeck's "combination" tones were, in fact, Ohm's "component waves." Within the ear, he argued, these waves are "subjectively" distorted and not "heard out" as simple waves.

By separating mechanics from psychology, Helmholtz was able to apply his "theory of signs" to acoustics. He contended that the mind, when receiving information of little use, generalizes the existence of the information through "unconscious inference." Thus, the experienced human ear finds the complex tones of voices and instruments "sufficient" to establish the identity of the sound-producing body. Hearing the component tones adds no useful information. Helmholtz's interest in acoustics, Turner speculates, developed from his earlier *optical* discovery: that for precisely the same utilitarian reason, the human eye does not see the "blind spot" where the optic nerve enters the retina.

Is the Sun Predictable?

"The Case of the Missing Sunspots" by John A. Eddy, in *Scientific American* (May 1977), 415 Madison Ave., New York, N.Y. 10017.

Sunspots—strong magnetic fields on the surface of the sun—have been thought to appear and disappear in 11-year cycles. Closely linked to the aurora borealis, or "northern lights," sunspots have for centuries been taken as evidence that the forces of the sun are constant and predictable. In 1893, however, E. Walter Maunder, Superintendent of the Royal Greenwich Observatory, made a curious and little-noted discovery. While perusing old astronomical records, he found that for a 70-year period ending in 1715, sunspots and other solar activity had virtually vanished from the sun.

Setting out to re-examine this "skeleton in the closet of solar physics," Eddy, an astronomer at the Harvard College and Smithsonian Astrophysical Observatories, confirms the accuracy of Maunder's original research. Between 1645 and 1715—a period which Eddy calls the "Maunder minimum"—there were few aurora sightings and not a single account of sunspot-induced streamers, which can be seen trailing from the sun's corona during an eclipse.

More intriguing evidence involves analysis of carbon 14 content—which correlates directly with solar activity—in the annual growth rings of the bristlecone pine. Plotting carbon 14 levels not only confirmed the Maunder minimum but revealed at least 12 other similar periods during the past 5,000 years, each lasting from 50 to 200 years and ushering in particularly cold eras in the history of the earth's climate. The Maunder minimum itself corresponds to the 17th century's so-called "little ice age."